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(54) **FUEL PUMP ASSEMBLY WITH GROUNDED PLASTIC COMPONENTS AND FUEL TANK ASSEMBLY THEREWITH AND METHOD OF CONTRUCTION THEREOF**

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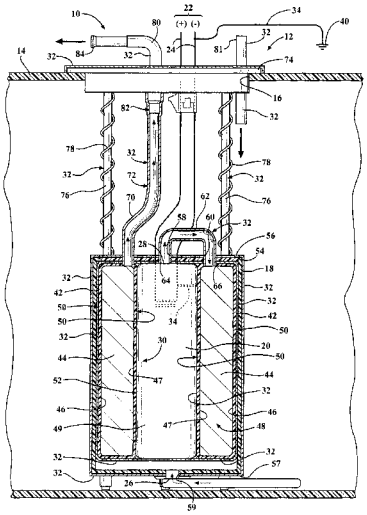
(57) **ABSTRACT**

A vehicle fuel pump assembly, method of construction thereof, and a fuel tank assembly is provided. The fuel pump assembly includes a non-conductive plastic reservoir and an electrically powered fuel pump disposed in the reservoir. The fuel pump is configured to receive fuel through an inlet and to dispense fuel through an outlet. A fuel filter assembly having a non-conductive plastic housing is disposed in the reservoir and a coating of conductive material is bonded to the housing. A conductive lead is configured in electrical communication with the coating and is further configured for attachment to an electrical ground.

24 Claims, 1 Drawing Sheet



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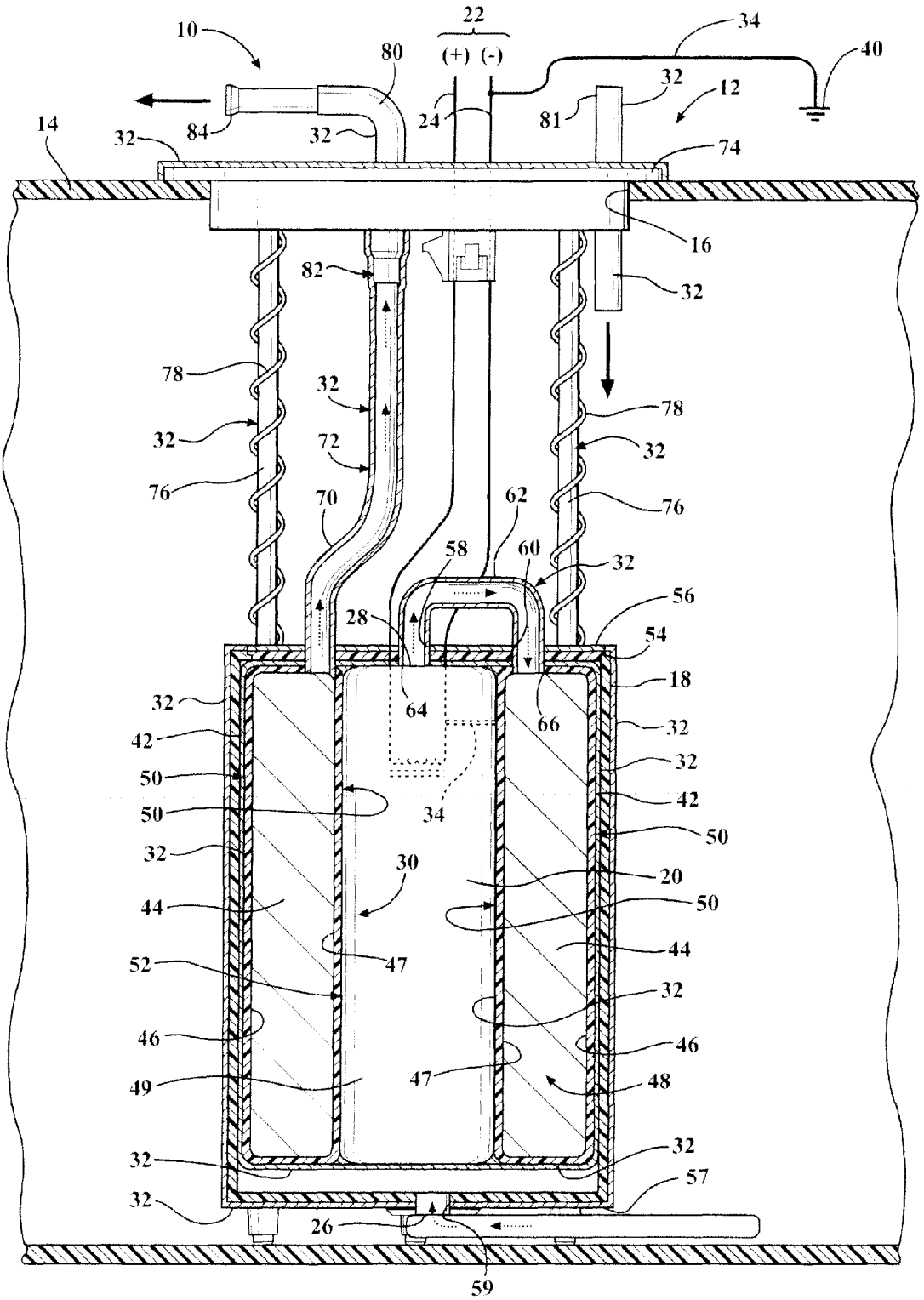
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FUEL PUMP ASSEMBLY WITH GROUNDED PLASTIC COMPONENTS AND FUEL TANK ASSEMBLY THEREWITH AND METHOD OF CONTRUCTION THEREOF

BACKGROUND OF THE INVENTION

1. Technical Field

This invention relates generally to a fuel system for an internal combustion engine, and more particularly to in-tank fuel pump assemblies.

2. Related Art

Modern vehicles are known to incorporate fuel tanks with fuel pumps contained therein, sometimes referred to as in-tank fuel pumps, wherein the fuel pumps have components constructed from impregnated conductive plastic materials, wherein the plastic is mixed with the conductive material and molded. Accordingly, the conductive plastic materials are molded from a mixture of plastic and conductive material which are premixed in a plastic resin manufacturing process. The conductive material within the molded component provides a conductive path through which electrostatic charges can be dissipated while also providing shielding against electromagnetic interference (EMI). However, a problematic issue with this type of molded material is the unpredictability of the conductive path and EMI protection provided. With the inherent variations of conductive material content and disbursement within the plastic material, the ability to provide a uniform and effective conductive path and barrier to EMI is jeopardized.

SUMMARY OF THE INVENTION

In accordance with one aspect of the invention, a vehicle fuel pump assembly is provided. The fuel pump assembly includes a non-conductive plastic reservoir and an electrically powered fuel pump disposed in the reservoir. The fuel pump is configured to receive fuel through an inlet and to dispense fuel through an outlet. A fuel filter assembly having a non-conductive plastic housing is disposed in the reservoir and a coating of conductive material is bonded to the housing. A conductive lead is configured in electrical communication with the coating and is further configured for attachment to an electrical ground.

In accordance with another aspect of the invention, a coating of conductive material is bonded to the reservoir.

In accordance with another aspect of the invention, a cover, configured for attachment about an opening of a fuel tank, is attached to the reservoir by a plurality of support members. The cover and support members have a coating of conductive material bonded thereto.

In accordance with another aspect of the invention, a fuel tank assembly is provided. The fuel tank assembly includes a fuel tank having an opening with a non-conductive plastic reservoir, an electrical fuel pump and a fuel filter assembly disposed in the fuel tank. The fuel pump is configured in electrical communication with a power source via a lead wire to receive fuel through an inlet and to dispense fuel through an outlet. Further, a coating of conductive material is bonded to the fuel filter assembly and a conductive lead is configured in electrical communication with the coating and configured for attachment to an electrical ground.

In accordance with another aspect of the invention, a coating of conductive material is bonded to the reservoir of the fuel pump assembly.

In accordance with another aspect of the invention, a method of constructing a fuel pump assembly is provided.

The method includes providing a non-conductive plastic reservoir and disposing a fuel filter assembly and an electrically powered fuel pump in the reservoir. The method further includes bonding a coating of conductive material to the fuel filter assembly, and configuring a conductive lead in electrical communication with the coating and for attachment to an electrical ground.

In accordance with another aspect of the invention, the method further includes performing the bonding by dipping the fuel filter assembly in a solution of the conductive material.

In accordance with another aspect of the invention, the method further includes bonding a coating of conductive material to the reservoir.

In accordance with another aspect of the invention, the method further includes performing the bonding by dipping the fuel filter assembly and reservoir in a solution of the conductive material.

In accordance with another aspect of the invention, the method further includes bonding the coating of conductive material to the fuel filter assembly and reservoir after disposing the fuel filter assembly in the reservoir.

In accordance with another aspect of the invention, the method further includes attaching a cover configured for attachment about an opening of a fuel tank to the reservoir with a plurality of support members and bonding a coating of conductive material to the cover and support members.

In accordance with another aspect of the invention, the method further includes bonding the coating of conductive material to the reservoir, fuel filter assembly, cover and support members in a single dipping process.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other aspects, features and advantages of the present invention will become more readily appreciated when considered in connection with the following detailed description of presently preferred embodiments and best mode, appended claims and accompanying drawings, in which:

FIG. **1** is a partially cross-sectioned side view of a fuel tank assembly and fuel pump assembly constructed in accordance with one aspect of the invention.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENTS

Referring in more detail to the drawings, FIG. **1** illustrates a fuel tank assembly **10** and fuel pump assembly **12** disposed therein, both constructed in accordance with the invention. The fuel tank assembly **10** includes a fuel tank **14** having an opening **16** through which the fuel pump assembly **12** is disposed for containment within the fuel tank **14**, thereby being an "in-tank" fuel pump assembly. The fuel pump assembly **12** includes a non-conductive plastic reservoir **18** with an electrical fuel pump **20** disposed in the reservoir **18**. The fuel pump **20** is configured in electrical communication with a power source **22** via conductive leads **24** and is powered to draw fuel through an inlet **26** and to pump fuel through an outlet **28**. The fuel pump assembly **12** has a fuel filter assembly **30** disposed in the reservoir **18**, with the fuel filter assembly **30** being provided as a toroid shaped cartridge surrounding the fuel pump **20**. To dissipate static electricity and to provide a shield against electromagnetic interference (EMI), the fuel filter assembly **30** has a conductive material coating **32** bonded thereto. The conductive material coating **32** is applied in a dipping process, and thus, it encapsulates or substantially encapsulates the entire fuel filter assembly **30** to

provide maximum coating coverage, thereby providing an uninterrupted conductive layer for maximum, reliable static electricity discharge and EMI protection. Accordingly, a reliable conductive path, represented schematically by a conductive lead **34**, is provided between the lead **34** that is in electrical communication with the coating **32** and an electrical ground **40** of the vehicle.

The fuel filter assembly **30** has a fuel filter housing **42** configured for receipt of a fuel filter **44**. The fuel filter housing **42** is illustrated as being toroid shaped, having generally cylindrical outer and inner walls **46**, **47** bounding an inner toroid shaped cavity **48** configured for receipt of the fuel filter **44**, with the inner wall **47** bounding a central passage **49** configured for close receipt of the fuel pump **20**. The housing **42** is dipped in the conductive coating **32**, and thus, an outer surface **50** of the inner and outer walls **46**, **48** has the coating **32** bonded thereto. As such, the conductive coating **32**, upon disposing the fuel pump **20** in the passage **49**, is brought into electrical communication with a metal housing **52** of the fuel pump **20**.

The non-conductive plastic reservoir **18** is configured for receipt of the fuel filter assembly **30** through an open end **54**. A base **57** of the reservoir **18** has an opening **59** configured for receipt of the fuel pump inlet **26**, and thus, after disposing the fuel filter assembly **30** in the reservoir **18**, the inlet **26** is received in the opening **59** and an end cover **56** is attached to close or substantially close the open end **54**. The end cover **56**, as with the reservoir **18**, is constructed of non-conductive plastic material. The end cover **56** has a plurality of openings configured for the flow of fuel therethrough. For example, a pair of the openings **58**, **60** are configured for receipt of opposite ends of a U-shaped tube **62**. One end **64** of the U-shaped tube **62** is attached in fluid communication with the outlet **28** of the fuel pump **20** and another end **66** directs the high pressure fuel into the cavity **48** of the fuel filter assembly **30**. Accordingly, the fuel flows into the cavity **48** and through the fuel filter **44** under high pressure and is directed to flow outwardly from the reservoir **18** through another opening **68** in the cover **56**. The fuel exiting the reservoir **18** is pumped under high pressure through a non-conductive plastic fuel supply tube **70**. The supply tube **70**, being operably attached to the housing **42**, is dipped in the conductive coating **32**, and thus, an outer surface **72** of the supply tube **70** has the coating **32** bonded thereto. As such, the conductive coating **32** continuous or substantially continuous about the entire surface of the fuel filter assembly **30**.

The fuel pump assembly **12** includes a cover **74** that is operably attached to the reservoir **18** by a plurality of support members **76**. The cover **74** and support members **76** are preferably constructed from non-conductive plastic and subsequently dipped in the conductive coating **32** along with the entire fuel pump assembly **12**. The cover **74** is configured for attachment about the opening **16** of the fuel tank **14**, wherein the support members **76** extend into the fuel tank **14** to bring the fuel pump assembly **12** into its desired location. As is known, spring members **78** can be disposed about the support members **76** to allow proper positioning the reservoir **18** within the fuel tank **14**. During insertion, the support members **76** can be caused to slide into the reservoir **18** and into the housing **42** (not shown in detail), while the spring members **78** become compressed. With both the cover **74** and support members **76** both having the bonded conductive coating **32**, the entire outer surface of the fuel pump assembly **12** provides a uniform and reliable conductive flow path through which static electricity (produced substantially by the flow of fuel) can flow, and further, provides a complete barrier to EMI. The cover **74** is shown supporting and receiving an outlet tube **80** and a return tube **81** therethrough. The outlet tube **80** has one end **82** configured for attachment to the supply tube **70** and an opposite end **84** configured for attachment to a fuel supply line (not shown) that channels fuel to an engine of the vehicle. The return tube **81** is configured to redirect fuel otherwise not burned or channeled to the engine back to the reservoir **18**. The outlet tube **80** and return tube **81** can both be made from non-conductive plastic tube material, and being attached to the cover **74**, both generally have the conductive coating **32** bonded thereto.

The conductive lead **34**, being in electrical communication with the conductive coating **32** and the ground **40**, is able to dissipate any electrical static charge generated within the fuel pump assembly **12** to the ground **40** in an economical and reliable fashion.

With the coating **32** covering all or substantially all exposed surfaces of the fuel pump assembly **12**, and with the coating **32** having a uniform or substantially uniform thickness and continuity, the conductive path provided to dissipate the electrical static charge is made uniform and reliable, while the at the same time, allowing the construction of the non-conductive plastic components to be economical, given they are constructed from any suitable, readily available standard plastic material.

The conductive coating **32**, such as those sold under the name Electrodag by Ladd Research of Williston, Vt., by way of example and without limitation, can be applied in the dipping process to each or selected ones of the non-conductive plastic components of the fuel pump assembly **12**, either individually or simultaneously as an assembly or subassembly. Accordingly, the fuel pump assembly **12** can be entirely or partially assembled, and thereafter, dipped as a complete assembly or subassembly in a solution of desired conductive material. As such, the process of manufacture is made economical by dipping the entire or substantially entire fuel pump assembly **12** in a single dipping process. In addition to being economical, all surfaces are assured of being uniformly coated, thereby ensuring full and reliable conductivity across the entirety of the fuel pump assembly **12** and grounding thereof.

Many modifications and variations of the present invention are possible in light of the above teachings. It is, therefore, to be understood that the invention may be practiced otherwise than as specifically described, and that the scope of the invention is defined by any ultimately allowed claims.

What is claimed is:

1. A vehicle fuel pump assembly, comprising:

a non-conductive plastic reservoir;

an electrically powered fuel pump disposed in said reservoir, said fuel pump being configured to receive fuel through an inlet and to dispense fuel through an outlet;

a fuel filter assembly having a non-conductive plastic housing disposed in said reservoir;

a coating of conductive material bonded to an exterior surface of said housing; and

a conductive lead configured in electrical communication with said coating and being configured for attachment to an electrical ground.

2. The vehicle fuel pump assembly of claim **1** further including a coating of conductive material bonded to said reservoir.

3. The vehicle fuel pump assembly of claim **2** wherein said conductive lead is configured in electrical communication with said coating on said reservoir.

4. The vehicle fuel pump assembly of claim **3** further including a cover attached to said reservoir by a plurality of support members, said cover being configured for attachment

about an opening of a fuel tank, said cover having a coating of conductive material bonded thereto.

5. The vehicle fuel pump assembly of claim **4** wherein said conductive lead is configured in electrical communication with said coating on said cover.

6. The vehicle fuel pump assembly of claim **4** wherein said plurality of support members have a coating of conductive material bonded thereto.

7. The vehicle fuel pump assembly of claim **1** wherein said fuel filter assembly is toroidal and surrounds said fuel pump.

8. The vehicle fuel pump assembly of claim **1** wherein said fuel pump is in electrical communication with said coating.

9. A fuel tank assembly, comprising:

a fuel tank having an opening;

a non-conductive plastic reservoir disposed in said fuel tank;

an electrical fuel pump disposed in said reservoir, said fuel pump being configured in electrical communication with a power source via a lead wire and being powered to receive fuel through an inlet and to dispense fuel through an outlet;

a fuel filter assembly disposed in said reservoir;

a coating of conductive material bonded to an exterior surface of said fuel filter assembly; and

a conductive lead configured in electrical communication with said coating and configured for attachment to an electrical ground.

10. The fuel tank assembly of claim **9** further including a coating of conductive material bonded to said reservoir.

11. The fuel tank assembly of claim **10** wherein said conductive lead is configured in electrical communication with said coating on said reservoir.

12. The fuel tank assembly of claim **11** further including a cover attached to said reservoir by a plurality of support members, said cover being configured for attachment about said opening of said fuel tank, said cover having a coating of conductive material bonded thereto.

13. The fuel tank assembly of claim **12** wherein said conductive lead is configured in electrical communication with said coating on said cover.

14. The fuel tank assembly of claim **12** wherein said plurality of supp01i members have a coating of conductive material bonded thereto.

15. The fuel tank assembly of claim **9** wherein said fuel filter assembly is toroidal and surrounds said fuel pump.

16. The fuel tank assembly of claim **9** wherein said fuel pump is in electrical communication with said coating.

17. A method of constructing a fuel pump assembly, comprising:

providing a non-conductive plastic reservoir;

disposing a fuel filter assembly in the reservoir;

disposing an electrically powered fuel pump disposed in the reservoir;

bonding a coating of conductive material to an exterior surface of the fuel filter assembly; and

configuring a conductive lead in electrical communication with the coating and for attachment to an electrical ground.

18. The method of claim **17** further including performing the bonding by dipping the fuel filter assembly in a solution of the conductive material.

19. The method of claim **17** further including bonding a coating of conductive material to the reservoir.

20. The method of claim **19** further including performing the bonding by dipping the fuel filter assembly and reservoir in a solution of the conductive material.

21. The method of claim **20** further including bonding the coating of conductive material to the fuel filter assembly and reservoir after disposing the fuel filter assembly in the reservoir.

22. The method of claim **17** further including attaching a cover configured for attachment about an opening of a fuel tank to the reservoir with a plurality of support members and bonding a coating of conductive material to the cover and support members.

23. The method of claim **22** further including bonding the coating of conductive material to the reservoir, fuel filter assembly, cover and support members in a single dipping process.

24. The method of claim **17** further including configuring the fuel pump in electrical communication with the coating of conductive material.

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